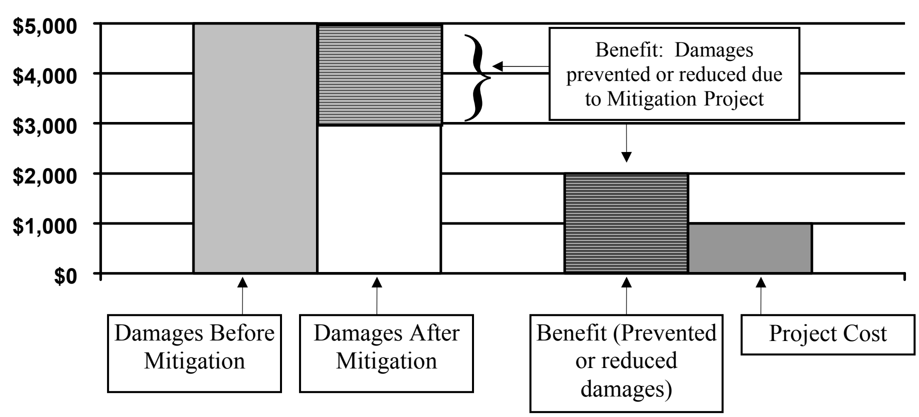
How to Determine Cost-Effectiveness Of Mitigation Projects

As the well-publicized devastation of floods, earthquakes, and hurricanes attests, disasters are random and inevitable events that we can't control. But how we reduce — or mitigate — damage from disasters is something that we *can* control. That is why FEMA funds hazard mitigation projects: to reduce future damages, losses, casualties, and other devastating impacts from disasters. Some examples of flood mitigation projects include elevating buildings or upgrading culverts. Projects in earthquake-prone areas might focus on retrofitting buildings to lower future damages and casualties. So instead of continuously picking up the pieces after disasters, states and communities can identify and carry out hazard mitigation measures that will reduce damage and hardship —the "loss"— due to future disasters. A key criterion for mitigation projects to be eligible for funding is that they must be cost-effective. If the project benefits are higher than the project costs, then the project is cost-effective.

Benefit-cost analysis is used for all cost-effectiveness determinations — for flood and earthquake mitigation projects alike. Although the following graph is an oversimplification, the concepts it illustrates are important. At its most basic level, benefit-cost analysis determines whether the cost of investing in a mitigation project today (the "cost") will result in sufficiently reduced damages in the future (the "benefits") to justify spending money on the project. If the benefit is greater than the cost, then the project *is* cost-effective; if the benefit is less than the cost, then the project *is not* cost-effective. This graph provides an example of the kind of comparative benefit and cost data you might see after conducting a benefit-cost analysis.

Basic Benefit-Cost Model



It is important to understand that benefit-cost analysis is basically the same for each type of hazard mitigation project. The only differences are the types of data that are used in the calculations, depending on whether the project is for floods, earthquakes, or other natural hazards. For example, whereas the depth of flooding is used to estimate damage for flood mitigation projects, the severity of ground shaking is used to estimate damage for earthquake mitigation projects.

For more information about FEMA's Benefit-Cost Modules, please contact the FEMA Region X Mitigation Division at 425-487-4600

Calculating the Benefit-Cost Ratio

In the previous graph, cost-effectiveness is determined by comparing the project cost of $1,000, to the value of damages prevented *after* the mitigation measure, which is $2,000. Because the dollar-value of benefits exceeds the costs of funding the project, the project is cost-effective. This relationship is depicted numerically by dividing the benefits by the costs, resulting in a benefit-cost ratio (BCR). The BCR is simply a way of stating whether benefits exceed project costs, and by how much. To derive the BCR, divide the benefits by the cost ($2,000 ÷ $1,000). If the result is 1.0 or greater, then the project is cost-effective. In this instance, the BCR is 2.0, which far exceeds the 1.0 level. On the other hand, if the cost of the project is $2,000 and the benefits are only $1,000, the project would have a BCR of 0.50 ($1,000 ÷ $2,000) and would not be cost-effective.

By conducting a benefit-cost analysis, you determine one of two things: either the project is cost-effective (BCR > 1.0) or it is not (BCR < 1.0). If the project is cost-effective, then no further work or analysis needs to be done; there is no third step other than to move the project to the next phase in the approval process. If, however, the project is not cost-effective, then it is not eligible for funding.

FEMA utilizes a computer software program to calculate a project's cost-effectiveness. The following is a technical illustration of how benefit-cost analysis works. There are four key elements to all benefit-cost analyses of hazard mitigation projects:

1. an estimate of damages and losses *before* mitigation

2. an estimate of damages and losses *after* mitigation

3. an estimate of the frequency and severity of the hazard causing damages (e.g. floods), and

4. the economic factors of the analysis (i.e. discount rate and mitigation project useful lifetime)

These four key elements and their relationships to one another are detailed in the following example.

EXAMPLE: Consider a 1500 square foot, one-story, single family residence located in the Acorn Park subdivision along Squirrel Creek. A proposed mitigation project will elevate the structure four feet at a cost of $20,000. Whether this project is cost-effective depends on the damages and losses from flooding without the mitigation project; the effectiveness of the mitigation project in reducing those damages and losses; the frequency that the house is flooded and the depth of the flood water; and, the mitigation project's useful lifetime.

If the pre-mitigation damages are frequent and/or severe, then the project is more likely to be cost-effective. Even minor damage that occurs frequently can exceed, over the life of a project, the up-front costs of implementing a mitigation measure. On the other hand, if the building in the example above only flooded once, then it may not be cost-effective to elevate, unless the damages were significant in relation to the value of the structure and its contents.

FEMA is trying to maximize its investment in damage reduction by focusing mitigation resources on those projects that have the best chance of making an impact on losses in property and life. Determining cost-effectiveness of mitigation projects is of critical importance, therefore, to ensure that FEMA is fulfilling its mission of not just responding to disasters, but also in reducing the economic loss and suffering that they bring.